

# CARADOCIAN BIVALVE MOLLUSCS FROM WALES

by S. P. TUNNICLIFF

**ABSTRACT.** The occurrence of a widespread, distinctive, and sometimes well-preserved bivalve fauna from the Lower Longvillian (Ordovician, Caradoc) rocks of North Wales is recorded, especially from the Allt-Tair-ffynon Beds at Allt y Gadair, south of Llanfyllin, Powys. Six species are described, of which *Cymatonota verisimilis* sp. nov., *Myodakryotus deigrjn* gen. et sp. nov., and *Pseudarca celtica* sp. nov. are new. The new family Myodakryotidae is established to accommodate the new genus *Myodakryotus*.

THE Allt-Tair-ffynon Beds (Caradoc, Soudleyan-Longvillian: Williams *et al.* 1972) of Allt y Gadair (SJ 145 175; text-fig. 1), south of Llanfyllin, Powys, Wales, yielded a number of well-preserved and unusual bivalves to early Geological Survey collectors in the late 1840s. These were studied by J. W. Salter, and were referred to by him in his palaeontological contribution to Ramsey's (1866) *Memoir*, 'The Geology of North Wales'.

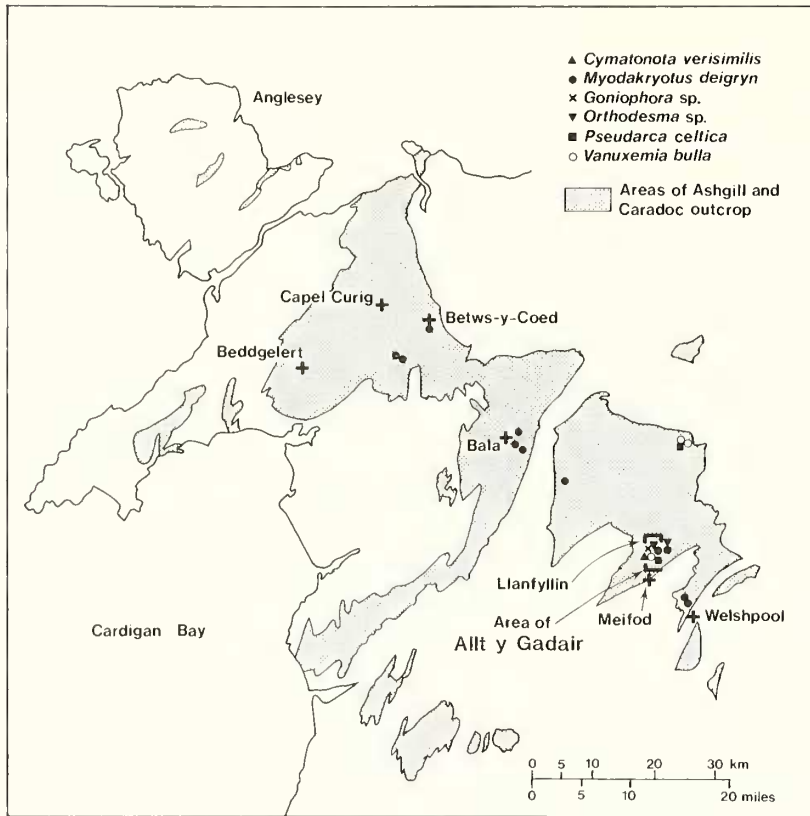
Some of the specimens listed in BGS records can no longer be accounted for, possibly because, in the past, such collections were often distributed for teaching purposes. However, the significant bivalves have survived and other specimens have been collected since.

The locality is recorded variously as Galt-y-Gader, Gallt y gader, Alt-y-gader, and Allt-y-Gader and is referred to as near Meifod or near Llanfyllin, both of which were used as field stations by Geological Survey collectors. There is no doubt, however, that these all refer to the same hill, though not necessarily exactly the same localities. On the old series Ordnance Survey maps it was spelt 'Gallt y Gader' but on new 1:50000 series maps it is 'Allt y Gadair', the form adopted herein. A copy of the old series geological map in the Biostratigraphy Research Group, BGS, has MS locality numbers and some notes on the reverse side; for Allt y Gadair, they are as follows, with grid references added:

Llanfyllin (station) 19 Gallt y Gader, Bala Lime? (SJ 1460 1715); 20 N. End of Gallt y Gader, Bala Lime? (SJ 1500 1815); 21 E. Flank of Gallt y Gader, Bala Lime? (SJ 1520 1715).

M'Coy knew of the locality and described *Arca Edmondiaformis* [*sic*] from there in 1851 (p. 52). Subsequently, in Sedgwick and M'Coy (1852, p. 352), he listed *Orthis expansa* (J. de C. Sowerby), *O. porcata* (M'Coy) and *A. Edmondiaformis* [*sic*] (M'Coy) as coming from Allt-y-Gader, near Llanfyllin, and he redescribed *A. Edmondiaformis* (p. 283, pl. 1k, figs. 2 and 3).

Wedd *et al.* (1929, pp. 42-45) recorded a single Caradoc bivalve from the area of Geological Survey sheet 137; an ?*Orthonota* (see *Orthodesmia* sp. herein) from Bryngwyn Camp, 3 km east of Allt y Gadair. Whittington (1938) recorded no bivalves from the nearby Llest Quarry but established a lower Longvillian age for the highest Allt-Tair-ffynon Beds. Although Drs Pickerill and Brenchley have collected widely over the area, their collections include no bivalves from Allt y Gadair (Brenchley, pers. comm., Feb. 1981). Dr N. J. Morris (pers. comm.) has also searched in vain for the bivalve-rich horizon. With the help of Dr D. E. White, I have examined exposures on the northern end of Allt y Gadair without finding any weathered rock precisely comparable with the known specimens. I conclude, therefore, that the original specimens came from lenses or beds now obscured.



TEXT-FIG. 1. Distribution of bivalve elements of the Caradocian Allt y Gadair fauna in North Wales.

#### DISTRIBUTION OF THE BIVALVE FAUNA

The species described here from the Allt-Tair-ffynon Beds at Allt y Gadair are:

- Cymatonota verisimilis* sp. nov.
- Myodakryotus deigryn* gen. et sp. nov.
- Goniophora* sp.
- Orthodesma* sp.
- Pseudarca celtica* sp. nov.
- Vanuxemia bulla* (Salter)

At least two of these species, *Goniophora* sp. and *V. bulla* also occur in the Bryn Siltstone Formation (Longvillian: Brenchley 1978, pp. 146–149) at Nant Iorwerth (SJ 216 364) near Glyn Ceiriog, south of Llangollen, some 20 km NNE of Allt y Gadair. The Nant Iorwerth specimens are associated with single specimens of *Lyrodesma* and *?Tancrediopsis* and with more numerous dalmanellid and sowerbyellid brachiopods. No *Lyrodesma* has been seen from the Allt y Gadair collections, nor any palaeotaxodont, although the old lists do record *Ctenodonta*. Specimens of *M. deigryn* are recorded from as far to the north-west as Betws-y-Coed and Roman Bridge, and as far south-east as the Welshpool area.

Also present in the collections from Allt y Gadair are the monoplacophoran *Cyrtolites nodosus* (Salter), the gastropod *Cyclonema crebristria* (M'Coy), and a number of other fragmentary unidentified gastropods, as well as the brachiopod *Macrocoelia* and dalmanellid brachiopod and trilobite fragments.

All the bivalve specimens from the Allt-Tair-ffynon Beds at Allt y Gadair are preserved in a highly fossiliferous, fine-grained rotten mudstone which is chocolate brown in colour when weathered. The specimens from Bala, Nant Iorwerth, and the other localities mentioned in this paper are also from fine-grained mudstones which are grey in colour.

All of the occurrences of these distinctive bivalve faunas are from approximately contemporaneous horizons of early Longvillian age. Indeed, the widespread and sudden appearance of these bivalve faunas with such unusual genera as *Myodakryotus* and *Pseudarca*, at lower Longvillian horizons is notable because over much of North Wales the appearance of a number of genera and species is taken as indicative of the onset of Longvillian times (e.g. Whittington 1962). In particular, the trilobites *Klouceki* and *Estoniops* and brachiopods such as *Howellites antiquior* (M'Coy) are taken as indicators of Longvillian age. Although scant attention has been paid previously to the molluscan faunas, the bivalves have a contribution to make to Caradocian biostratigraphy as well as palaeoecology.

*Pseudarca* is known principally from France, but the rest of the Allt y Gadair bivalves are of eastern North American aspect. There is, however, a notable lack of taxodont or other smaller infaunal forms such as the actinodontoid *Lyrodesma*. All the specimens available are of similar size and this feature and the fragmentary nature of many of the associated trilobite and brachiopod fragments suggests that they are part of a well-sorted thanatocoenosis in which burrowing forms such as *Cymatonota* and *Orthodesma* are mixed with semi-infaunal *Vanuxemia* and presumably epifaunal *Goniophora* and *Myodakryotus*.

Specimen numbers bearing the prefix BGS are housed in the collections of the British Geological Survey, Keyworth; those with the prefix SM are in the Sedgwick Museum, Cambridge; those with NMW are in the National Museum of Wales, Cardiff; and BM indicates the British Museum (Natural History).

#### SYSTEMATIC PALAEOLOGY

In general, the classification used by Pojeta (1978) is adopted. Synonymies follow the recommendations of Matthews (1973).

Subclass ISOFILIBRANCHIA Iredale, 1939

Family MODIOMORPHIDAE Miller, 1877

Genus *Goniophora* Phillips, 1848

*Type species. Goniophora cymbaeformis* (J. de C. Sowerby), by original designation of Phillips (1848, p. 264). The genus has been discussed recently by Liljedahl (1984).

*Goniophora* sp.

Plate 76, figs. 6 and 9

*Material.* BGS Zv 2018a and b (internal moulds of two valves, an almost complete left valve, and a fragmentary right valve), from Allt y Gadair, Llanfyllin.

*Description.* The material available shows the shell to be equivalve, prosogyrate, and apparently rhomboidal with a pronounced sigmoidal carina extending from the umbo towards the posteroventral margin. Dorsal margin straight, anterior margin rounded, posterior margin possibly truncated obliquely. The area dorsal from the carina has one or two coarse but faint radial ribs, and the rest of the shell shows a fairly coarse concentric ornament. Musculature, dentition, and ligament unknown.

*Remarks.* Of the two specimens of *Goniophora* sp. the right valve, BGS Zv 2018b, is fragmentary but the left, Zv 2018a, is nearly complete. From Britain, Reed (1905, p. 500, pl. 24, fig. 15) and Hind (1910, p. 539, pl. 4, figs. 24–27) have described and illustrated Ordovician *Goniophora* spp., but both appear more elongate than the present specimens. *G. carinata* (Hall) from the Ottawa

Formation (Black Riveran–Trentonian) from Canada, redescribed by Wilson (1956, p. 76, pl. 9, fig. 20), is closer in size and shape to the Welsh specimens. A single specimen of a *Goniophora* (BGS Zs 2751) from the Killy Bridge Formation (Ashgill, Cautleyan) of the Pomeroy Inlier, Co. Tyrone, was described by Tunnicliff (1982, p. 80, pl. 12, fig. 15), and has proportions similar to the Welsh specimens.

A slab (BGS Zv 2010) from the Bryn Siltstone Formation at Nant Iorwerth (SJ 216 364) bears a fragment of the posterior part of a left valve closely corresponding to the Allt y Gadair fragments and probably represents the same form. The Nant Iorwerth specimen is associated with sowerbyellid and dalmanellid brachiopods and with single specimens of *Lyrodessa* and ?*Tancrediopsis*.

Subclass PTERIOMORPHIA Beurlan, 1944

Family CYRTODONTIDAE Ulrich, 1894

Genus *Vanuxemia* Billings, 1858

*Type species.* *Cyrtodonta rugosa* Billings, 1858, by subsequent designation of Williams and Breger (1916, p. 149).

*Vanuxemia bulla* (Salter, 1866)

Plate 76, figs. 11–15; Plate 77, fig. 11; text-fig. 2a–c

v\* 1866 *Palaearca?* *bulla* Salter, p. 344, woodcut 13, fig. 3 (two views), p. 270 (in list).

*Type material.* BGS GSM 12397 is here selected as lectotype. This is the specimen figured by Salter (*in* Ramsey 1866), an internal mould of a left valve from the Allt-Tair-ffynon Beds at Allt y Gadair. Paralectotypes are BGS GSM 12398, Zv 2018, internal moulds of right valves from the same horizon and locality. Other material consists of BGS GSM 22190, an internal mould of a left valve, and NMW.27.110.G609, an internal mould of a right valve, from the Bryn Siltstone Formation (Longvillian) at Nant Iorwerth (SJ 216 364), and two specimens, SM 53554–53555, from the same horizon at Bryn Quarry, Glyn Ceiriog, which are internal moulds of left and right valves respectively. There are also three specimens in BM(NH), BM 42791, a right valve, internal mould, recorded as from Meifod; BM L13156, a large right valve, internal mould, from Glyn Ceiriog; BM PL4436 labelled 'W.pool 21m2', left valve, internal mould, probably from Allt y Gadair.

*Description.* Strongly inflated *Vanuxemia* (maximum inflation of 17 mm in a valve 26 mm long), in which the height is one-tenth to one-fifth greater than the length and the umbo is at about the anterior one-tenth to one-fifth. The hinge line is straight with sets of anterior and posterior teeth separated by an edentulous area. There are three anterior teeth on a hinge plate, the most posterior being hoeshoe shaped in the left valve. There are apparently two ridge-like posterior teeth in the left valve and one in the right. The anterior

#### EXPLANATION OF PLATE 76

Figs. 1–5. *Orthodesma* sp. 1 and 3, dorsal and left lateral views of internal mould, conjoined valves, BGS GSM 22055. 2 and 4, dorsal and right lateral views, internal mould, conjoined valves, BGS GSM 24287. Both from Allt-Tair-ffynon Beds, Allt y Gadair, Llanfyllin. 5, left lateral external view of gaping conjoined valves, BM 44492, from Meifod.

Figs. 6 and 9. *Goniophora* sp., dorsal and lateral views of internal mould, left valve, BGS Zv 2018, from Allt-Tair-ffynon Beds, Allt y Gadair, Llanfyllin.

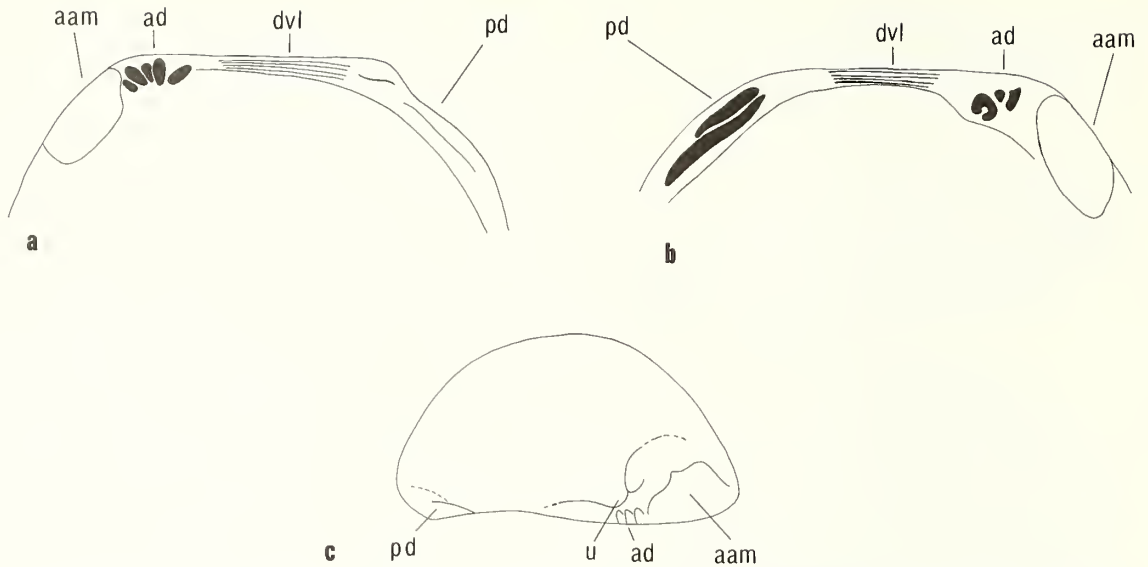
Figs. 7, 8, 10. *Pseudarca celtica* sp. nov. Holotype, BGS GSM 24179, internal mould, left valve; 7 and 10, latex cast, 8, lateral view.

Figs. 11–15. *Vanuxemia bulla* (Salter 1866). 11 and 15, lectotype, BGS GSM 12397, anterior and lateral views of internal mould, left valve. Allt-Tair-ffynon Beds, Allt y Gadair, Llanfyllin. 12 and 13, lateral and anterior views, internal mould, right valve, NMW.27.110.G609, from the Bryn Siltstone Formation, Nant Iorwerth, Glyn Ceiriog (NGR SJ 216364). 14, latex of hinge area of internal mould, left valve, BGS GSM 22190, horizon and locality as for 12 and 13.

All  $\times 2$  except Fig. 10, which is  $\times 4$ .







TEXT-FIG. 2. *Vanuxemia bulla* (Salter),  $\times 2$ . *a*, NMW 27.110.G609, latex, right valve. *b*, BGS GSM 22190, latex, left valve. *c*, BM (NH) PL4436, dorsal view, internal mould, left valve. u = umbo, aam = anterior adductor muscle scar, ad = anterior dentition, pd = posterior dentition, dvl = duplivincular ligament.

adductor muscle scar is strongly impressed and large, about one-quarter of the height of the shell in height. Posterior adductor muscle scar not discernible. Ornament of coarse concentric undulations only faintly seen on the internal moulds.

*Remarks.* The lectotype no longer shows the dentition illustrated by Salter (*in* Ramsey 1866, woodcut 13, fig. 3) but this is seen in one specimen from Nant Iorwerth (BGS GSM 22190, Pl. 76, fig. 14; text-fig. 2*b* and NMW.27.110.G609, Pl. 76, figs. 12 and 13; text-fig. 2*a*). A single posterior tooth is seen in a specimen of the right valve (BM 42791).

The strongly inflated valve and general appearance of *V. bulla* corresponds well with that generally accepted for *Vanuxemia*. However, its dentition does not readily compare with the better preserved North American material of *Vanuxemia* and *Cyrtodonta* such as that illustrated by Pojeta (1971, pls. 6–9; 1978, pls. 8 and 9).

#### EXPLANATION OF PLATE 77

Figs. 1–10. *Myodakryotus deigrayn* gen. et sp. nov. 1–4, holotype, BGS GSM 22040. 3, internal mould, right valve; 1, 2, 4, oblique ventral, oblique anterodorsal and lateral views of latex cast. 5, internal mould, left valve, BGS GSM 22041. All from the Allt-Tair-ffynon Beds, Allt y Gadair, Llanfyllin. 6, external lateral view of right valve, BGS GSM 22053, from Gelli-Grin Formation, Pont Rhiwedog, Bala, Gwynedd. 7 and 8, external lateral views of two right valves, BGS DJ 3338, 3337 from beds of Longvillian age near Roman Bridge, Gwynedd (NGR SH 7163 5121). 9, external lateral view of right valve, BGS Zv 2032, from Allt-Tair-ffynon Beds, near Cefn Lleyfnog, Llanfyllin. 10, external lateral view of right valve, BGS Zv 1468, from Gelli-Grin Formation, Cwm Chwilfod, Bala (NGR SH 955 400).

Fig. 11. *Vanuxemia bulla* (Salter 1866). Internal mould, right valve, BGS Zv 2018, Allt-Tair-ffynon Beds, Allt y Gadair, Llanfyllin.

All  $\times 2$ .





TUNNICLIFF, *Myodaktryotus*, *Vanuxemia*

## Family MYODAKRYOTIDAE nov.

*Type genus.* *Myodakryotus* gen. nov. here designated.

*Diagnosis.* Heteromyarian, pectiniform pteriomorphs with variable ornament.

*Description.* Equivalve, pectiniform, heteromyarian, prosogyrate pteriomorphs with small anterior and posterior ears and variable ornament.

*Known stratigraphic range.* Restricted to Ordovician rocks of Caradoc age in Britain and their approximate equivalents (Black Riveran, Trentonian; see Ross *et al.* 1982) in North America.

*Remarks.* A new family is established here to accommodate *Myodakryotus* gen. nov., which is considered to be synonymous with New Genus 10 of Pojeta (1978), subsequently referred to by Pojeta and Runnegar (1985) to *Prolobella?*, and generically similar to those specimens described by Wilson (1956, p. 56) as *Actinopterella? tessellata* Wilson.

The affinities of *Myodakryotus* are far from clear, but the combination of dimyarian musculature with the pectiniform shape, distinctive, almost cardinal dentition, and apparent lack of a duplivincular ligament precludes its being placed in any of the three families of Pteriomorphia recognized from the Ordovician: Cyrtodontidae, Ambonychiidae, and Pterineidae (Pojeta 1978, p. 235). The shell form is closest to that of a pterineid (if the pectinacean resemblance is discounted) but the dentition is strongly reminiscent of the anterior dentition in some cyrtodontids (e.g. *C. saffordi* (Hall), Pojeta 1978, pl. 8, fig. 11).

Pojeta and Runnegar (1985, p. 327) placed the Ordovician limiform shells which they assigned to *Prolobella* in the Limidae 'for now', and (Pojeta 1985, fig. 2) suggested that the Limacea might be derived from the Cyrtodontidae approximately during Caradoc times. This seems likely as outlined below, but the presence of the distinct anterior adductor muscle in *Myodakryotus* precludes its placement in the strictly monomyarian Limidae and I am obliged to propose the family Myodakryotidae to bridge the gap between the Cyrtodontidae and the Limidae.

I suggest that the Myodakryotidae could be derived from a cyrtodontid form by the acquisition of pectiniform shape, involving a development of the anterior portion of the shell, leaving the anterior teeth and adductor muscle close to the umbo, and the loss of the posterior dentition and reduction of the ligament. This would presumably reflect a change in life-style from the infaunal cyrtodontid type to a byssate epifaunal existence as suggested for the Ambonychiidae and some pterineids (Pojeta 1971, pp. 32-34).

Whether the Myodakryotidae have any direct bearing on the possible origins of the Pectinacea has yet to be fully determined.

Genus *Myodakryotus* nov.

1978 New genus 10 Pojeta, p. 239, pl. 12, figs. 1-8.

*Derivation of name.* Compounded from Greek *myo-dakrytos*, muscle, tearful, and rendered euphonicly in Latin form with masculine gender. The name refers to the teardrop-shaped anterior adductor muscle scar and the shape of some internal moulds (e.g. Pl. 77, fig. 5).

*Type species.* *M. deigryn* here designated.

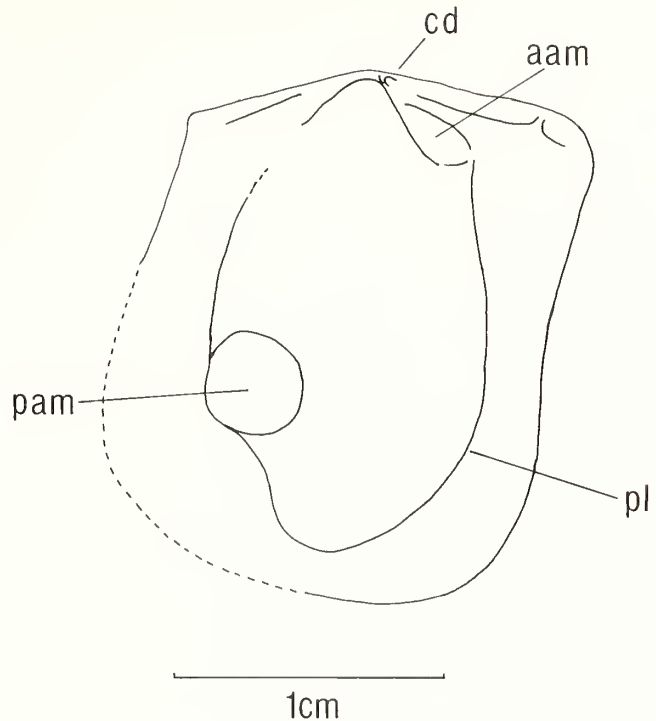
*Diagnosis.* As for family.

*Description.* As for family.

*Other species.* *M. hermione* (Billings), from the upper Middle Ordovician (Pojeta 1978, p. 239, pl. 12, figs. 1-8; Pojeta and Runnegar 1985, p. 327, fig. 17) and *M. tessellatus* (Wilson) from the Ottawa Formation (Black Riveran-Trentonian age) of eastern Canada. Judging from the published information the three species may be distinguished by their ornaments. The figures by Pojeta and Runnegar (1985, fig. 17A, B) of *M. arctica* (Schuchert) from the Upper Ordovician of Baffin Island, Canada, reveal no ornament.



TEXT-FIG. 3. *Myodakryotus deigrzyn* gen. and sp. nov., holotype, BGS GSM 22040, internal mould right valve,  $\times 2$ . cd = cardinal dentition, pl = pallial line, aam = anterior adductor muscle scar, pam = posterior adductor muscle scar.



*Myodakryotus deigrzyn* gen. et sp. nov.

Plate 77, figs. 1–10; text-fig. 3

*Derivation of name.* Welsh *deigrzyn* (m), a tear; from the teardrop-shaped anterior adductor muscle scar and the shape of some internal moulds (e.g. Pl. 77, fig. 5).

*Material.* Holotype, BGS GSM 22040, internal mould, right valve (a second, less well-preserved internal mould, right valve, on the same slab is a paratype) and paratype, BGS GSM 22041, internal mould, left valve, all from Allt-Tair-flynnon Beds, Allt y Gadair, Llanfyllin. Other paratypes are BGS GSM 22052, 22053, right valves from the Gelli Grin Formation (Longvillian), Pont Rhiwedog, near Bala, Gwynedd (exact locality uncertain but in the area of SH 947 348) and BGS Zv 2032, 2033, slabs with left and right valves from the Allt-Tair-flynnon Beds near Cefn Lleyfnog, Llanfyllin; BGS DJ 3337, 3338, two right valves from rocks in the Cwm Eigiau Formation of Longvillian age near Roman Bridge, Gwynedd (SH 7163 5121); BGS Zv 1468, external of right valve from the Gelli Grin Formation at Cwm Chwilfod, north-east of Bala (SH 955 400); BGS Zv 913, external of left valve (incomplete) from the Gelli Grin Formation at Bryn Cut, Bala (c. SH 951 344); BGS Zv 646 from Waterloo Bridge, Betws-y-Coed; BGS Zv 2557, 2558 and Zv 2541 from the area of Moel y Garth and the Quakers' Burial Ground, north-west of Welshpool; NMW.77.11G.307 (Brenchley Collection) from the Cwm Rhiwarth Siltstone Formation at Cwm Rhiwarth (SJ 020 296). All specimens are from horizons within the Longvillian stage of the Caradoc.

*Description.* Orthocline, prosogyrate, subcircular, equivalve, equilateral shell of pectiniform appearance, a little higher than long (h:l 1.0 to 1.1), with small anterior and posterior ears. Inflation of a single valve about 5 mm in a shell 30 mm high. Teeth a little anterior from beak and with the form of a single chevron or horseshoe-shaped tooth with a simple tooth posterior to and parallel with the posterior limb of this. Ligament uncertain, but possibly opisthodontic, from the nature of the dorsal margin (but a duplivincular ligament is possible: see remarks below). A shallow groove extends from below the beak towards the posterior ear. Musculature heteromyarian: a subcircular posterior adductor muscle scar, about one-fifth of the height of the shell in diameter and situated well within the body of the shell; the anterior adductor muscle scar is tear-drop

shaped, close to the umbo and anterodorsal margin, to which its axis is subparallel. Accessory muscles unknown. Pallial line complete, non-sinuate and co-marginal (generally at a distance of about one-sixth of the width of the shell from the margin) extending from the anterior end of the anterior muscle scar, touching the outer edge of the posterior adductor muscle scar, where it shows a slight embayment, and returning towards the umbo. Ornament of generally fine concentric lines, occasionally coarser especially on or near the ears; some specimens show faint radial ornament. The area dorsal of the anterior muscle scar is separated from it by a strong ridge, a weaker extension of which bisects the area and meets the anterodorsal angle of the shell.

*Remarks.* It is perhaps surprising that such a distinctive species, collected so widely in North Wales at a particular horizon has not been described before and it is especially remarkable that Salter (1866) made no mention of it. The only forms known to resemble *M. deigryn* are those figured by Pojeta (1978, pl. 12, figs. 1–8) as New genus 10 *hermione* Billings from the upper Middle Ordovician, and specimens described by Wilson (1956, p. 56, pl. 7, figs. 8–11) from the Ottawa Formation (Black Riveran–Trentonian age) of eastern Canada, as *A. tessellata* Wilson. Pojeta subsequently (Pojeta and Runnegar, 1985, p. 327, fig. 17) reassigned New genus 10 *hermione* and another species, *arctica* (Schuchert), from the upper Ordovician of Baffin Island, Canada, to *Prolobella* Ulrich with a qualifying question mark. He stated (1978, p. 239) that the musculature of his New genus 10 was poorly known and that the ligament and dentition were unknown, but that the ornament is of co-marginal growth lines and fine radial ribs. By 1985 (Pojeta and Runnegar 1985, p. 327) he had more internal detail including (pers. comm.) evidence of a duplivincular ligament, but the dentition remained unknown and he referred to a single, posterior adductor muscle suggesting that the anterior adductor muscle was not recognizable in the specimens before him. In some of the Welsh specimens radial ornament is apparent but faint. With the larger, strongly impressed anterior muscle scar, they differ from the American species which in turn seem, from Pojeta's illustrations (1978, pl. 12, fig. 6) to have a more strongly impressed posterior muscle scar. However, the similarities are otherwise so great that one must conclude that the two species are closely allied and place them in the same genus. Wilson's figures show most of the features of the Welsh specimens, but have a tessellated ornament and poorly known musculature and dentition.

Ulrich's original figure of his *P. striatula* (1897, pl. 35, fig. 27) suggests a more prosocline form lacking any posterior auricle. His description (1897, p. 532) as 'very inequilateral' seems contrary to the evidence presented by *Myodakryotus*. In the absence of a revised description of the type material of *Prolobella* I feel the establishment of the new genus is justifiable.

#### Subclass ORTHONOTIA Pojeta, 1978

This subclass was established by Pojeta (1978, p. 240) to accommodate five genera: *Cymatonota*, *Orthodesma*, *Palaeosolen*, *Psiloconcha*, and an unnamed genus. Taxonomy at the level of order, superfamily and family remains unestablished.

#### Genus *Cymatonota* Ulrich, 1893

*Type species.* By original designation *C. typicalis* Ulrich (1893, p. 661).

#### *Cymatonota verisimilis* sp. nov.

Text-fig. 4a, b

v. 1866 *Orthonota verisimilis* MSS Salter, p. 270 (in list only), *nom. nud.*

*Type specimens.* Holotype designated here, BM 42792, an internal mould of conjoined valves, complete except for the extreme posterior portion, recorded as from Meifod, but possibly from Allt y Gadair (obtained from W. Prosser); paratypes BGS GSM 24292, 24293 from Allt y Gadair, Llanfyllin.

*Description.* Valves very elongate with parallel dorsal and ventral margins. Height less than a quarter of the length. The inflation of a single valve is about a quarter of the height. The umbo is almost terminal anteriorly,



TEXT-FIG. 4. *Cymatonota verisimilis* sp. nov.,  $\times 2$ . *a*, holotype, BM 42792, left lateral view, internal mould, conjoined valves, recorded as from 'Meifod'. *b*, BGS GSM 24292, lateral view, posterior portion, right valve, Allt-Tair-ffynon Beds, Allt y Gadair, Llanfyllin. The richly fossiliferous nature of the bivalve-bearing rocks at this locality can be seen in this figure; present are trilobite, brachiopod, and gastropod fragments including *Cyrtolites nodosus* (Salter).

and the positions of the muscle scars are uncertain, although an area in the preumbonal region of the shell may represent an anterior adductor muscle scar about half as high as the shell. Details of the ligament and dentition are unknown. The ornament consists of two zones of ornament separated by a line running from the umbo to the posteroventral angle (no carina or ridge is developed) as seen in recent *Ensis* spp. Ventral to this line, the ornament is of parallel, fairly coarse (c. 1 per mm) co-marginal lines which undulate gently in section. The posteroventral ornament is of similar co-marginal lines but with a stronger and more irregular undulation. There was a permanent posterior gape.

*Remarks.* The dimensions of the holotype are: height 12.0 mm, length 54.0 mm, and inflation of a single valve 3.5 mm. Ornament is best seen in the paratypes, both of which are fragmentary. BGS GSM 24293 is an internal mould of a section of the right postumbonal shell about 25 mm long and showing the dorsal margin with a thin fragment of the left valve in place. BGS GSM 24292 also shows the internal mould, postumbonal section (c. 50 mm) of a right valve but with the umbo itself missing. Both specimens have a height of about 13 mm and both show the nature of the posterior ornament. The posterior end of the shell in BGS GSM 24292 suggests the presence of a permanent gape.

Although Salter (1866, p. 270) clearly intended to describe this species as *Orthonota verisimilis*, he never did so and his use of that taxon becomes invalid as a *nomen nudum*. It is reintroduced here to retain the association with Salter's work and to avoid future confusion. It was recorded



in one of the old Geological Survey lists as '*Orthonota vessimilis* (sic) MSS exactly like *Solen*'. Compared with other species of *Cymatonota* (e.g. Ulrich 1893, pl. 55, figs. 1-14; Pojeta 1978, pl. 15, figs. 9, 11-13), *C. verisimilis* is distinctive in its remarkably parallel dorsal and ventral margins and its almost terminal umbones.

Genus *Orthodesma* Hall and Whitfield, 1875

*Type species.* By original designation, *Orthodesma rectum* Hall and Whitfield (1875, p. 93).

*Orthodesma* sp.

Plate 76, figs. 1-5

v. 1866 *Orthonota* sp. Salter, p. 270 (in list).

*Material.* Three internal moulds of conjoined valves, BGS GSM 22055, 24286, 24287 all from Allt y Gadair, Llanfyllin; BGS WK 339, conjoined valves from Bryngwyn Camp, near Llanfyllin; BM 42793, 44492-44494, BM L13526, 13547, left, right, and conjoined valves all recorded as from Meifod and purchased from W. Prosser.

*Description.* Elongate, modioliform or soleniform shell with height about half the length, tapering rapidly towards the anterior end, with the highest part of the shell towards the posterior end. The umbones are at about the anterior quarter. Maximum inflation of the two valves coincides with the highest part of the shell and is 14.5 mm in a shell 42.7 mm long (BGS GSM 24287). Posterior dorsal margin straight, anterior dorsal margin drops away from umbo. Posterodorsal margin truncate, posteroventral margin rounded, anterior margin rounded, ventral margin nearly straight or with a sinus a little posterior to the umbo and, in some, anterior to the umbo. Adductor muscle scars of subequal size and round to ovate; anterior adductor scar almost terminal, posterior adductor scar faint, below posterodorsal angle and in the upper half of the shell. Pallial line not distinguishable. Details of ligament and dentition not known. Ornament of concentric undulations about 2 mm apart, faint on the internal moulds, and finer comarginal lines (c. 5 per mm).

*Remarks.* Two of the specimens (BGS GSM 22055, 24287) appear to be inequivalve, but this is probably the result of distortion, for they are inequivalve in opposite senses, and most of the other specimens suggest an equivalve condition. None of the specimens shows a clear gape at either end as is suggested for the genus by Ulrich (1894, p. 516). Pojeta (1971, p. 24) also expressed doubt over this feature.

Subclass ACTINODONTIA Pojeta, 1978

Family LYRODESMATIDAE Ulrich, 1894

Genus *Pseudarca* Tromelin and Lebesconte, 1875

*Type species.* *Pseudarca typa* Tromelin and Lebesconte. This genus was treated as a nuculoid by McAlester (1968, p. 47), who redescribed the type species and discussed synonyms.

*Pseudarca celtica* sp. nov.

Plate 76, figs. 7, 8, 10

? 1866 *Orthonota* sp. Salter, p. 270 (in list).

*Material.* Holotype, BGS GSM 24179, an internal mould, left valve, from the Allt-Tair-ffynon Beds at Allt y Gadair, Llanfyllin. A slab in the Sedgwick Museum, SM A53554, from the Bryn Formation, Bryn Quarry, Glyn Ceiriog, bears what appears to be the anterior portion of an internal mould of conjoined valves of *P. celtica*. On the same slab is a specimen of *Vanuxemia bulla* (q.v.).

*Description.* Elongate, with a rounded anterior end and probably a rounded posterior end (the posterodorsal angle is missing). The dorsal margin is straight behind the umbo and curves continuously with the anterior margin before the umbo. The ventral margin is gently curved such that the highest part of the shell is behind the umbo, a little anterior to the midpoint. Dimensions of the holotype: length 22.5 mm, height 7.4 mm,

h: 1.0-33, maximum inflation of the single valve *c.* 1.5 mm. The umbo is at about the anterior one-fifth, it is small and opisthogyrate. A hinge plate behind the umbo is just over one-tenth of the height of the shell high and 0.13 of the length of the shell in length, and it tapers towards the posterior. It bears eight radiating, possibly striated teeth which are longer towards the posterior. A single tooth lies anterior to the umbo. Immediately behind the umbo is a faint, poorly-developed sulcus extending perpendicularly downwards and fading rapidly. Ligament unknown but probably opisthodontic. An elongate anterior muscle scar lies immediately anterior to the umbo with a strongly impressed dorsal edge and bounded on the anterior edge by a rounded ridge running close to the anterodorsal margin. The posterior adductor muscle scar is unknown. Ornament unknown.

*Remarks.* I know of no previous record of *Pseudarca* from Britain. Babin (1966, pp. 243-244, pl. 9, figs. 4-6, 8) has described *Siliquarca* [= *Pseudarca*] *typa* Tromelin and Lebesconte, the type species, and has placed several other French species in synonymy with it. However, *P. typa* has almost twice as many posterior teeth as *P. celtica* and appears to taper more towards the posterior. Despite the conventional view of the genus as a nuculoid (McAlester, 1968, p. 47; 1969, p. N234), Babin (1966, p. 237) placed *Siliquarca* in the family Lyrodesmatidae and the features shown in this species tend to corroborate his opinion.

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